

**WHAT IS CLAIMED IS:**

1. An apparatus for heat treating semiconductor wafers comprising:

a thermal processing chamber adapted to contain at least one semiconductor wafer;

5 a heat source in communication with said thermal processing chamber for heating semiconductor wafers contained in said chambers;

a substrate holder for holding semiconductor wafers contained in said thermal processing chamber;

10 and

a cooling device located proximate to said substrate holder for selectively cooling semiconductor wafers contained in said thermal processing chamber, said cooling device comprising a cooling member  
15 maintained at a lower temperature than the maximum processing temperature of the semiconductor wafer.

2. An apparatus as defined in claim 1, wherein said cooling device is movable towards and away from said substrate holder for selectively cooling said semiconductor wafers.

3. An apparatus as defined in claim 1, wherein said cooling member has a plate-like shape.

4. An apparatus as defined in claim 1, wherein said cooling member is made from a material comprising a metal.

5. An apparatus as defined in claim 1, wherein said substrate holder is movable towards and away from said cooling device for selectively cooling said semiconductor wafers.

6. An apparatus as defined in claim 2, wherein said cooling device is configured to directly contact semiconductor wafers held on said substrate holder when said wafers are cooled.

7. An apparatus as defined in claim 2, wherein

said cooling device is configured to be positioned adjacent to but not in contact with semiconductor wafers held on said substrate holder when said wafers are cooled.

8. An apparatus as defined in claim 1, wherein said cooling device further contains at least one gas passage for flowing a gas therethrough, said gas passage being configured to direct said gas towards semiconductor wafers held on said substrate holder for cooling said wafers.

9. An apparatus as defined in claim 1, wherein said heat source comprises a plurality of light energy sources.

10. An apparatus as defined in claim 1, wherein said cooling device further comprises a cooling fluid source for supplying a cooling fluid for circulation through cooling channels defined by said cooling member, said cooling fluid comprising a liquid.

11. An apparatus as defined in claim 1, further comprising:

a temperature sensing device for sensing the temperature of a semiconductor wafer contained in said processing chamber; and

a controller in communication with said temperature sensing device, with said heat source and with said cooling device, said controller receiving temperature information from said temperature sensing device and, based on said information, controlling said heat source and said cooling device for heating and cooling said semiconductor wafer according to a predetermined heat cycle.

12. An apparatus for heat treating semiconductor wafers comprising:

a thermal processing chamber adapted to contain at least one semiconductor wafer;

5                   a heat source in communication with said  
thermal processing chamber for heating semiconductor  
wafers contained in said chamber, said heat source  
comprising a plurality of light energy sources;

10                   a substrate holder for holding semiconductor  
wafers contained in said thermal processing chamber;  
and

15                   a cooling device located proximate to said  
substrate holder for selectively cooling said  
semiconductor wafers contained in said thermal  
processing chamber, said cooling device comprising a  
cooling member which is maintained at a lower  
temperature than the maximum processing temperature of  
the semiconductor wafer, said cooling device further  
comprising a movement mechanism for moving said  
20                   cooling device between an engagement position wherein  
said cooling device is placed adjacent to a  
semiconductor wafer held on said substrate holder and  
a non-engagement position wherein said cooling device  
is spaced a determined distance from said  
25                   semiconductor wafer.

13. An apparatus as defined in claim 12, wherein  
said cooling device is made from a material comprising  
a metal.

14. An apparatus as defined in claim 12, wherein  
said cooling device directly contacts a semiconductor  
wafer held on said substrate holder when said cooling  
device is placed in said engagement position.

15. An apparatus as defined in claim 12, further  
comprising a cooling fluid source for supplying a  
cooling fluid for circulation through a cooling fluid  
channel defined by said cooling member, said cooling  
5                   fluid comprising a liquid.

16. An apparatus as defined in claim 12, further  
comprising:

a temperature sensing device for sensing the temperature of a semiconductor wafer held on said substrate holder; and

a controller in communication with said temperature sensing device, with said heat source, and with said cooling device, said controller receiving temperature information from said temperature sensing device and, based on said information, controlling said power source and said cooling device for heating and cooling a semiconductor wafer according to a predetermined heat cycle.

17. An apparatus as defined in claim 12, wherein said cooling device is placed adjacent to a semiconductor wafer held on said substrate holder without contacting said wafer when said cooling device is placed in said engagement position.

18. An apparatus for heat treating semiconductor wafers comprising:

a thermal processing chamber adapted to contain at least one semiconductor wafer;

a heat source in communication with said thermal processing chamber for heating semiconductor wafers contained in said chamber, said heat source comprising a plurality of light energy sources;

a substrate holder for holding semiconductor wafers contained in said thermal processing chamber; and

a cooling device located proximate to said substrate holder for selectively cooling semiconductor wafers contained in said thermal processing chamber, said cooling device comprising a cooling member maintained at a lower temperature than the maximum processing temperature of the semiconductor wafer, said cooling device further containing gas passages for flowing a gas therethrough, said gas passages

20 being configured to direct said gas towards  
semiconductor wafers held on said substrate holder for  
cooling said wafers.

19. An apparatus as defined in claim 18, further  
comprising:

5 a temperature sensing device for sensing the  
temperature of a semiconductor wafer held on said  
substrate holder; and

10 a controller in communication with said  
temperature sensing device and with said heat source,  
said controller receiving temperature information from  
said temperature sensing device and, based on said  
information, controlling said heat source for heating  
said semiconductor wafer according to a predetermined  
heat cycle.

20. An apparatus as defined in claim 19, wherein  
said cooling device further comprises a gas source for  
supplying a gas to said gas passages, said gas source  
being in communication with said controller such that  
5 said controller is configured to start and stop the  
flow of gas from said gas source to said gas passages  
for selectively cooling semiconductor wafers in said  
thermal processing chamber.

21. A method for rapidly heating semiconductor  
wafers in a thermal processing chamber, said method  
comprising the steps of:

5 placing a semiconductor wafer in a thermal  
processing chamber;

rapidly heating said semiconductor wafer to  
a predetermined maximum temperature using light  
energy; and

10 rapidly cooling said semiconductor wafer  
through the use of an active cooling device, said  
cooling device comprising a cooling member maintained  
at a temperature lower than the wafer.